# THE MEETING OF PRINCIPAL INVESTIGATORS OF THE JOINT U.S.-U.S.S.R. PROGRAM IN CHEMICAL CATALYSIS

PRINCETON, NEW JERSEY, U.S.A.

June 23-25, 1975

# PROTOCOL

## OF THE MEETING OF PRINCIPAL INVESTIGATORS OF THE JOINT U.S.-U.S.S.R. PROGRAM IN CHEMICAL CATALYSIS

PRINCETON, NEW JERSEY, U.S.A.

June 23-25, 1975

In accordance with the U.S.-U.S.S.R. Agreement on Cooperation in the Fields of Science and Technology of May, 1972, and in accordance with the decisions taken at the meetings of the principal investigators of the U.S.-U.S.S.R. Program in Chemical Catalysis at Novosibirsk, U.S.S.R., July 16-19, 1974, a Joint U.S.-U.S.S.R. Symposium was held in Princeton on June 23-25, 1975, on the following topics of cooperative research in the field of chemical catalysis:

Topic 1 - Catalysis by Coordination Complexes and Organometallic Compounds

Topic 2 - Catalytic Reactor Modeling

Topic 3 - In-Depth Study of Selected Catalytic Systems

Topic 4 - Application of Catalysis to Life Support Systems for Possible Use in Future Space Exploration

Topic 5 - Environmental Control

From the Soviet side, the following principal investigators took part in the meeting:

Academician G. K. Boreskov (Institute of Catalysis, Siberian Branch of the Academy of Sciences, Novosibirsk)

Corresponding Member of the Academy of Sciences M. G. Slin'ko (Institute of Catalysis, Novosibirsk)

Dr. Ya. B. Gorokhovatskii (Institute of Physico-Chemistry, Kiev)

Dr. V. M. Gryaznov (Peoples Friendship University, Moscow)

Dr. A. A. Ivanov (Institute of Catalysis, Novosibirsk)

Corresponding Member of the Academy of Sciences V. B. Kazanskii (Institute of Organic Chemistry, Moscow)

Dr. D. A. Kondratiev (Institute of Organic Chemistry, Moscow)

Dr. O. V. Krylov (Institute of Chemical Physics, Moscow)

Dr. A. E. Shilov (Institute of Chemical Physics, Moscow)

Dr. K. C. Yatsimirskii, Director (Institute of Physical Chemistry, Kiev)

From the American side, the following principal investigators took part:

Dr. J. D. Baldeschwieler (California Institute of Technology)

Dr. A. T. Bell (University of California, Berkeley)

Dr. Michel Boudart (Stanford University)

Dr. J. J. Carberry (Notre Dame University)

Dr. Vladimir Haensel (Universal Oil Products)

Dr. W. Keith Hall (University of Wisconsin, Milwaukee)

Dr. Jack Halpern (University of Chicago)

Dr. J. W. Hightower (Rice University)

Dr. G. W. Keulks (University of Wisconsin, Milwaukee)

Dr. Leon Lapidus (Princeton University)

Dr. John G. Larsen (General Motors Research Laboratories)

Dr. Dan Luss (University of Houston)

Dr. E. L. Muetterties (Cornell University)

Dr. John Turkevich (Princeton University)

Dr. W. H. Weinberg (California Institute of Technology)

Dr. A. H. Weiss (Worcester Polytechnic Institute)

The following U.S.S.R. research fellows also participated in the Symposium at Princeton:

Dr. Andrei Skliarov (with Dr. Keulks)

Dr. Vladislov Seleznev (with Dr. Weiss)

Dr. Valdislov Shvets (with Dr. Boudart)

The U.S. research fellows attending the Symposium included:

Dr. C. L. Kibby (Gulf Research & Development Co.)

Dr. E. L. Kugler (Johns Hopkins University)

Dr. Michael Maclaury (General Electric Co.)

Dr. Thomas Notermann (University of Wisconsin, Milwaukee)

Dr. K. C. Taylor (General Motors Research Laboratories)

Dr. D. W. Van Leirsburg (Oregon Graduate Center for Study & Research)

Dr. Thomas Weil (Amoco Research Center)

The scientific sessions of the conference included presentations by Soviet and American investigators as indicated in the Symposium agenda attached as Appendix I. It was noted that the joint program in catalysis has produced significant scientific results of mutual interest which have been published in the Soviet and American scientific literature. The details of progress in each of the five projects included in the Joint Program are described in Appendices IV-VIII. As a result of meetings of the U.S.-U.S.S.R. Program Coordinators, and individual project leaders, a number of general organizational matters were discussed, and a number of policies defined as the basis of collaboration in chemical catalysis for 1975-1976.

ORGANIZATIONAL MATTERS

1. The administrative and financial arrangements for implementing the program of cooperation in chemical catalysis appear to be working well. The Foreign Relations Department of the U.S.S.R. Academy of Sciences, and the American Chemical Society were congratulated for their skillful administration of the joint program.

2. The activity in each of the projects in the joint program in terms of man-months is summarized in Table I. The names and institutional affiliations of each of the research fellows involved in the program are indicated in Appendix II. On the basis of the data provided in Table I, a number of problems are apparent:

a. In Project 1, only one Soviet fellow has worked in a U.S. laboratory. One Soviet Principal Investigator, Dr. Mark E. Vol'pin, has not yet visited the United States, nor have any of the investigators from his laboratory in the Institute of Organo-Element Chemistry been cleared for work in the United States laboratory of Professor Halpern.

b. No Soviet fellows from Project 2, Reactor Modeling, have been cleared for work in the United States.

The activity in Projects 3-5, all areas involving heterogeneous catalysis, appears to conform generally with the terms of the protocol of July 16-19, 1974.

April 1974 - December 1975

Man-months

| | 1. Coordination Complexes | | 2. Reactor Modeling | | 3. Selected Systems | | 4. Life Support Systems | | 5. Environmental Control | |
|---|---|---|---|---|---|---|---|---|---|---|
| | US | USSR | US | USSR | US | USSR | US | USSR | US | USSR |
| 1974, and 1975 in progress | 14 1/2 | 6 | 4 | - | 24 | 12 | 6 | 6 | 3 | - |
| 1975, proposed | 6 | - | - | - | - | 18 | - | - | - | - |
| Total | 20 1/2 a/ | 6 b/ | 4 a/ | - | 24 a/ | 30 b/ | 6 a/ | 6 b/ | 3 a/ | - |

a/ Coordination Complexes: MacLaury, Weil, Magnuson, Pretzer
Reactor Modeling: Bruns
Selected Systems: Kibby, Notermann, Taylor, Conner, Miner
Life Support Systems: Partridge
Environmental Control: Van Leirsburgh

b/ Coordination Complexes: Zamaraev
Selected Systems: Shvets, Skliarov, Mastihin, Savchenko, Tapilin
Life Support Systems: Seleznev

5.


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3. It was agreed that the addition of new topics and new principal investigators to the Joint Program should be deferred until the general terms of the July 1974 agreements had been fulfilled. In particular, it was agreed that a proposal by Professors Yeager (Case Western Reserve University, Cleveland, Ohio) and Frumkin (Institute of Electrochemistry, Moscow) to add the topic of electrochemical catalysis to the Joint U.S.-U.S.S.R. Program in Chemical Catalysis should be deferred for at least one year.

4. It was agreed that implementation of a Joint Program of research between Professors A. Shilov (Institute of Chemical Physics, Moscow) and John Bercaw (California Institute of Technology, Pasadena, California) should be deferred until progress has been made on the program of cooperation agreed to between Professor Halpern (University of Chicago) and Professor Vol'pin (Institute of Organo-Element Chemistry, Moscow).

5. It was agreed that Topic 2, Reactor Modeling, would be reviewed in one year, and that if progress in assignment of Soviet fellows to U.S. laboratories had not been made, consideration would be given to recommending to the Joint Commission that Project II be eliminated from the Joint Program.

6. The total volume for visits of research fellows per year for each topic for each side which was agreed to in July 1974 is shown in Table II. It was noted that the total of 60 man-months is too small in comparison with the commitments already made to programs and principal investigators in both countries. It was agreed that an annual volume of activity of 90 man-months of research fellow time would be more desirable than 60 man-months. The proposed new distribution of research fellow time to the five projects is also shown in Table II.

Table II.

Man-Months Per Year For U.S. Or U.S.S.R. Research Fellows

| | June 1974 Agreement | Proposed New Volume of Activity |
|---|---|---|
| | Man-Months | Man-Months |
| Topic 1 | 18 | 24 |
| Topic 2 | 12 | 18 |
| Topic 3 | 18 | 36 |
| Topic 4 | 6 | 6 |
| Topic 5 | 6 | 6 |

It was noted that the original working agreement signed in Moscow on September 29, 1972 called for a total of 90 man-months of activity of junior scientists. Drs. Boreskov and Baldeschwieler agreed to propose the new level of activity at the next meeting of the Joint Commission in October 1975.

7. It was noted that the opportunity for travel and visits to academic and industrial research laboratories provided to Soviet principal investigators and research fellows in the United States were far more numerous than those provided to American principal investigators and research fellows in the Soviet Union. The travel opportunities provided to four Soviet research fellows in the United States and eight U.S. research fellows in the Soviet Union are shown in Table III. The U.S. group expressed the need for reciprocity in the availability of access to research institutions in the Soviet Union which is comparable to the access provided to the Soviets to American research institutions. The travel itineraries of the Soviet principal investigators in the U.S. are also attached in Appendix III.

8. The participants from the U.S. and the U.S.S.R. express their warm thanks to Professor John Turkevich for his able organization of the Princeton Symposium.

TABLE III



VISITS AND/OR ATTENDANCES BY USSR RESEARCH FELLOWS

(Univ. and Industry Laboratories - Meetings)

Dr. Kirill I. ZAMARAEV - 6 months research at Cornell Univ. with Prof. E. Muettertie
Nov. 29, 1974 - May 29, 1975

4/6/75 - Univ. of Chicago, Prof. Halpern
4/25/75 - Northwestern Univ., Prof. B. M. Hoffman
4/28-29 - Argonne Natl. Lab., Argonne, Ill., Dr. M. Mathesc
5/1-2 - Kettering Lab., Yellow Springs, Ohio, Dr. W. Newt

5/3-5/21- San Francisco - Stanford, Prof. M. Boudart
5/22/75 - UCLA, Prof. M. F. Hawthorne
5/23/75 - Cal Tech, Prof. J. E. Bercaw
5/24/75 - Sightseeing in Los Angeles
5/25/75 - Return to Chicago
5/26/75 - Wilmington, Del. - Du Pont, Dr. G. Parshall
5/27/75 - New York City - sightseeing
5/28/75 - departure for Moscow

Dr. Vladislav A. SHVETS - 7 months research at Stanford Univ. with Prof. M. Boudart
Nov. 29, 1974 - June 29, 1975

11/3-11/10 Texas A & M, College Station, TX, Prof. J. H. I
5/21-23 - Univ. of Wisconsin-Milwaukee, Prof. W.K. Hall
5/24-26 - Gulf Res. & Develop. Co., Dr. C. L. Kibby
5/29/75 - Return to Stanford
6/22/75 - Princeton, N.J. - Symposium
6/26/75 -
6/29/75 New York City - Sightseeing
Evening, June 29 - departure for Moscow

TABLE III (continued)

Dr. Andrey V. SKLIAROV - 6 months research at the University of Wisconsin with Prof. G. W. Keulks - Jan. 3, 1975 - 2 months extension requ

| | |
|---|---|
| 3/20-23 - | Fourth North American Meeting of the Catalysis Society, Toronto, Canada |
| 5/10-5/11- | Sightseeing in Chicago |
| 5/12/75 - | Attending the Catalysis Club's Symposium at the Illinois Institute of Technology |
| 5/13/75 - | Northwestern Univ., Evanston, Ill., Prof. R. L. Burwell & Prof. H. Pines |
| 5/14 - 5/20 - | California Institute of Technology 'Prof. J. D. Baldeschwieler, Prof. W. H. Weinber |
| 5/20-23 - | Stanford University, Prof. M. Boudart; Univ. of California, Prof. G. A. Somorjai |
| 5/24-5/26 | Sightseeing in San Francisco |
| 5/26/75 | Return to the Univ. of Wisconsin via Chicago |
| 6/22/75 - | Travel to Princeton via New York City US/USSR Symposium - Chem. Catalysis Program |
| 6/26/75 - | Return to the Univ. of Wisconsin |

Dr. Vladislav A. SELEZNEV -6 months research at Worcester Polytechnic Institute with Prof. A. H. Weiss - Jan. 3, 1975 - 2 months extension reque

| | |
|---|---|
| 3/20-3/23 - | Fourth North American Meeting of the Catalysis Society, Toronto, Canada |
| 5/10-11 - | Sightseeing in Chicago |
| 5/12/75 - | Attending the Catalysis Club's Symposium at the Illinois Institute of Technology |
| 5/13/75 - | Northwestern University, Evanston, Ill. Prof. R. L. Burwell & Prof. H. Pines |
| 5/14 - 5/20 - | California Institute of Technology, Prof. J. D. Baldeschwieler & Prof. W. H. Weinberg; Union Oil Company, Brea, Calif., Dr. John W. War |
| 5/20-23 - | Stanford University, Prof. M. Boudart |
| 5/24-5/26 | Sightseeing in San Francisco |
| 5/27 - | New York City - sightseeing |
| " evening | Return to Worcester |
| 6/22/75 - | Travel to Princeton, N. J. - US/USSR Symposium, Chemical Catalysis Program |
| 6/26/75 - | Return to Worcester |

Table III (continued)

US-USSR PROGRAM OF COOPERATION IN CHEMICAL CATALYSIS

US RESEARCH FELLOWS - RECORD OF VISITS

IN THE USSR

| | |
|---|---|
| Dr. William C. Conner<br>(Univ. of Wisconsin) | Research at the Institute of Organic Chemistry, M<br>(Prof. V. B. Kazanskiy)<br>March 1 - July 10, 1975<br><br>Visits:<br>Institute of Physical Chemistry, Kiev - 3 days<br>Institute of Catalysis, Novosibirsk - 1 week |
| Dr. Charles L. Kibby<br>(Univ. of Wisconsin) | Research at the Institute of Organic Chemistry, M<br>(Prof. V. B. Kazanskiy)<br>April 18 - October 18, 1974<br><br>Visits:<br>Institute of Catalysis, Novosibirsk - 1 week<br>Institute of Chemical Physics and<br>Institute of Organo-Element Chemistry, Moscow<br>A touristic visit to Leningrad arranged and pai<br>for by the USSR Academy of Sciences. A guide<br>provided by the University of Leningrad. No vi<br>to Univ. laboratories arranged. - 1 week |
| Dr. Dean A. Van Leirsburg<br>(Rice Univ.) | Research at the Institute of Catalysis, Novosibir<br>(Academ. G. K. Boreskov)<br>May 23 - August 23, 1974<br><br>No visits to laboratories requested. |
| Dr. Michael R. MacLaury<br>(Stanford Univ.) | Research at the Institute of Catalysis, Novosibir<br>(Prof. Yu. I. Yermakov)<br>April 18 - August 30, 1974<br><br>Visits:<br>Brief visits to the Institute of Organic Chemis<br>and the Institute of Inorganic Chemistry,<br>Novosibirsk;<br><br>Institute of Organic Chemistry and Institute of<br>Organo-Element Chemistry, Moscow<br><br>Arranged through intourist at personal expense -<br>visits to Irkutsk, Lake Baykal, Tashkent, Alma<br>Tbilisi, Kiev - total of 10 days |

Table III (continue



| | |
|---|---|
| Dr. Robert C. Miner (Princeton Univ.) | Research at the Kirghiz SSR Academy of Sciences, Alma Ata (Academician D. V. Sokolskiy)<br><br>April 7 - June 23, 1975<br><br>A brief visit to Patrice Lumumba Univ., Moscow (Discussions with Profs. Shimulis, Pavlova and Yagodovskiy)<br><br>Arranged through intourist at personal expense - visits to Tashkent, Samarkand, Bukhara, Khiva, Pendzhikent, and Leningrad - 1 week |
| Mr. Thomas Notermann (Univ. of Wisconsin) | Research at the Institute of Chemical Physics, Mosc (Prof. O. V. Krylov)<br><br>May 29 - November 30, 1974<br><br>Visits to research laboratories at the Institute of Organic Chemistry and the Institute of Inorganic Chemistry, Moscow;<br><br>Institute of Catalysis, Novosibirsk - 1 week (Participated in the First Annual Joint US-USSR Symposium of the Chemical Catalysis Program)<br><br>A touristic visit to Leningrad arranged and paid for by the USSR Academy of Sciences. A guide was provided by the University of Leningrad. No visits to University laboratories arranged - 1 week |
| Dr. Kathleen C. Taylor (GM Res. Laboratories) | Research at the Institute of Catalysis, Novosibirsk (Academician G. K. Boreskov)<br><br>Oct. 15, 1974 - January 15, 1975<br><br>Brief visits to the research laboratories at the Institute of Organic Chemistry and the Institute of Chemical Physics, Moscow;<br><br>Institute of Physical Chemistry, Kiev - 4 days.<br><br>Arranged through intourist at personal expense - visits to Alma Ata - 2 days;<br>Tashkent - 3 days;<br>Samarkand - 1 day. |

Table III (continued)

| | |
|---|---|
| Dr. Thomas Weil<br>(Univ. of Chicago) | Research at the Institute of Organo-Element Chemistry, Moscow (Prof. M. E. Vol'pin)<br><br>April 18 - August 19, 1975<br><br>Institute of Catalysis, Novosibirsk - 1 week<br>(Participated in the First Annual Joint US-USSR Symposium, Chemical Catalysis Program)<br><br>Institute of Polymer Chemistry, Leningrad - 1 week<br><br>Arranged through intourist at personal expense - visits to Zagorsk, Vladimir and Suzdal'. |

9. It was agreed to plan a third U.S.-U.S.S.R. Symposium on Chemical Catalysis to be held in the Soviet Union, tentatively, at Kiev on July 5-7, 1976.

Coordinator from American side,
Dr. J. D. Baldeschwieler

Coordinator from Soviet side,
Academician G. K. Boreskov

APPENDIX I

# US-USSR SYMPOSIUM

# in

# CHEMICAL CATALYSIS

PRINCETON CONFERENCE

June 23-25, 1975

Frick Chemical Laboratory
Department of Chemistry
Princeton University
Princeton, N.J. 08540

US Chairman

Professor John D. Baldeschwieler
Chairman, Division of Chemistry & Chemical Engineering
California Institute of Technology
Pasadena, California

USSR Chairman

Academician G. K. Boreskov
Director, Institute of Catalysis
Siberian Division, USSR Academy of Sciences
Novosibirsk, USSR

Sunday, June 22, 1975

5:00-7:00 p.m. - Registration, Nassau Inn Lobby

Monday, June 23, 1975

8:15 a.m. Registration - Lobby, Frick Chemical Laboratory

8:45 a.m. - Kresge Auditorium

Welcome

Professor John Turkevich
Princeton University

Opening Remarks

Professor John Baldeschwieler
California Institute of Technology

Academician G. K. Boreskov
Institute of Catalysis, Novosibirsk

Plenary Session

Professor Earl L. Muetterties, Chairman
Cornell University

9:00 a.m. Academician G. K. Boreskov
Institute of Catalysis, Novosibirsk

10:00 a.m. Professor Leon Lapidus
Princeton University
"On Some Features of Packed Bed Modeling and Simulation"

11:00 a.m. Dr. A. Y. Shilov
Institute of Chemical Physics, Moscow

12:00 Luncheon - Local restaurants

Monday Afternoon, June 23, 1975

Section A — HOMOGENEOUS CATALYSIS

Seminar Room 303
Third Floor

Professor Jack Halpern, Chairman
University of Chicago

Redox Chemistry of Organometallic Compounds

2:00 p.m. Professor Jack Halpern
University of Chicago

Dr. Thomas Weil
Amoco Research Center
Naperville, Illinois

Dr. K. B. Yatsimirskii
Institute of Organic Chemistry
Kiev, USSR

Nitrogen Fixation

3:30 p.m. Professor J. E. Bercaw
California Institute of Technology
"Dinitrogen Complexes of Permethyltitanocene and Permethylzirconocene"

Dr. A. Y. Shilov
Institute of Chemical Physics
Moscow

Professor Charles McKenna
University of Southern California, Los Angeles

Dr. M. E. Vol'pin
Institute of Organo-Elemental Compounds
Moscow

6:00 p.m. Reception and Banquet
Princeton Faculty Club
Prospect

Monday Afternoon, June 23, 1975

Section B HETEROGENEOUS CATALYSIS

Kresge Auditorium
First Floor

Hydrogenation

Professor W. Keith Hall, Chairman
University of Wisconsin, Milwaukee

2:00 p.m. Professor John Turkevich
Princeton University

Professor Michel Boudart
Stanford University

Dr. Vladislov Shvets
Institute of Organic Chemistry
Moscow

Professor V. M. Gryaznov
Peoples Friendship University
Moscow

Oxidation

3:00 p.m. Professor George W. Keulks
University of Wisconsin, Milwaukee

Dr. Andrey V. Sklyarov
Institute of Chemical Physics
Moscow

Dr. Oleg V. Krylov
Institute of Chemical Physics
Moscow

Dr. Thomas M. Notermann
University of Wisconsin, Milwaukee

Dr. Y. B. Gorokhvatskii
Institute of Physical Chemistry
Academy of Sciences, Kiev, USSR

Monday Afternoon, June 23, 1975

Section B. (cont.) HETEROGENEOUS CATALYSIS

NO Decomposition

4:00 p.m. Dr. Vladimir Haensel
University Oil Products
Des Plaines, Illinois

Academician G. K. Boreskov
Institute of Catalysis
Novosibirsh, USSR

Professor J. W. Hightower
Rice University
Houston, Texas
"Isotopic Tracer Studies of NO Reduction by Methane over a $Pt/Al_2O_3$ Catalyst"

Professor Alexis T. Bell
University of California, Berkeley
"Infrared Spectra of Adsorbed Species Present During the Reduction of NO over Platinum"

6:00 p.m. Reception and Banquet
Princeton Faculty Club
Prospect

Monday Afternoon, June 23, 1975

Section C — REACTOR MODELING

DuPont Seminar Room 324
Third Floor

Professor James J. Carberry, Chairman
University of Notre Dame
South Bend, Indiana

2:00 p.m. Professor Dan Luss
University of Houston
Houston, Texas

"Pitfalls in the Modeling of Reacting Mixtures"

3:00 p.m. Dr. M. G. Slin'ko
Institute of Catalysis
Novosibirsk, USSR

4:00 p.m. Professor James J. Carberry
University of Notre Dame
South Bend, Indiana

"A Comparison of Fixed-Bed and Tubular Wall Reactors for the Oxidation of Naphthalene"

6:00 p.m. Reception and Banquet
Princeton Faculty Club
Prospect

Tuesday Morning, June 24, 1975

Plenary Session
Kresge Auditorium
First Floor

Professor E. Peterson, Chairman
University of California, Berkeley

9:00 a.m. Dr. Mikhail M. Slin'ko
Institute of Catalysis
Novosibirsk

10:00 a.m. Professor E. L. Muetterties
Cornell University
"Catalytic Hydrogenation of Aromatic Hydrocarbons"

11:00 a.m. Dr. V. B. Kazansky
Institute of Organic Chemistry
Moscow

12:00 Luncheon - Local Restaurants

Tuesday Afternoon, June 24, 1975

Section A — HOMOGENEOUS CATALYSIS

Seminar Room 303
Third Floor

Professor Jack Halpern, Chairman
University of Chicago

Activation of Hydrocarbons and Related Catalytic Phenomena

2:00 p.m. Professor G. W. Parshall
E.I. du Pont de Nemours & Co.

"Homogeneous Catalytic Activation of C-H Bonds"

Dr. A. E. Shilov
Institute of Chemical Physics
Moscow

Professor Jack R. Norton
Princeton University

Metal Clusters and Supported Catalysts

3:30 p.m. Professor E. L. Muetterties
Cornell University

"Catalysis Chemistry of Metal Clusters"

Dr. Y. Yermakov
Institute of Catalysis
Novosibirsk

Dr. Michael MacLaury
Chemical Laboratory
General Electric Co.

6:00 p.m. Group Dinners (no host)

Tuesday Afternoon, June 24, 1975

Section B — HETEROGENEOUS CATALYSIS

Kresge Auditorium
First Floor

Professor W. Keith Hall, Chairman
University of Wisconsin, Milwaukee

## Acid Catalysis

2:00 p.m. Professor W. Keith Hall
University of Wisconsin, Milwaukee

"Some Interesting Properties of the Alumina Surface"

Dr. V. B. Kazansky
Institute of Organic Chemistry
Moscow

Dr. Charles L. Kibby
Gulf Research & Development

Academician G. K. Boreskov
Institute of Catalysis
Novosibirsk

Dr. Y. B. Gorokhovatsky
Institute of Physical Chemistry
Academy of Sciences, Kiev

## Application of Catalysis to Life Support Systems for Possible Use in Future Space Exploration

3:00 p.m. Professor Alvin H. Weiss
Worcester Polytechnic Institute

Dr. Vladislav Seleznev
Institute of Chemical Physics
Moscow

Tuesday Afternoon, June 24, 1975

Section B. (cont.) HETEROGENEOUS CATALYSIS

Chemical Physics

4:00 p.m. Dr. John G. Larson
General Motors Corporation

"Measurement of Sulfur Oxidation States on Platinum/Alumina"

Dr. Peter A. Zhdan
Institute of Catalysis
Novosibirsk

Dr. K. C. Taylor
General Motors Corporation

Dr. Oleg V. Krylov
Institute of Chemical Physics
Moscow

Academician G. K. Boreskov
Institute of Catalysis
Novosibirsk

Professor W. Henry Weinberg
California Institute of Technology

"The Interaction of Carbon Monoxide with the (111) Surface of Indium"

6:00 p.m. Group Dinners (no host)

Tuesday Afternoon, June 24, 1975

Section C — REACTOR MODELING

DuPont Seminar Room 324
Third Floor

Professor James J. Carberry, Chairman
University of Notre Dame

2:00 p.m. Professor W. Harmon Ray
State University of New York, Buffalo

"A Structural Framework for Modeling Emulsion, Suspension, and Precipitation Polymerization Reactors"

3:00 p.m. Dr. A. A. Ivanov
Institute of Catalysis
Novosibirsk

4:00 p.m. Professor Eugene F. Petersen
University of California, Berkeley

6:00 p.m. Group Dinner (no host)

Wednesday Morning, June 25 1975

Plenary Session

Kresge Auditorium
First Floor

Professor George W. Keulks, Chairman
University of Wisconsin, Milwaukee

9:00 a.m. Dr. Oleg V. Krylov
Institute of Chemical Physics
Moscow

10:00 a.m. Professor W. Keith Hall
University of Wisconsin, Milwaukee

12:00 Luncheon

Wednesday Afternoon, June 25, 1975

VISITS TO PRINCETON LABORATORIES

# U.S. RESEARCH FELLOWS

| Research Fellow | Project Area | Location | Date of Arrival, USSR | Length of Visit |
|---|---|---|---|---|
| Dr. Charles L. Kibby<br>Gulf Research & Development Co. | Catalytic Systems | Institute of Organic Chemistry, Moscow | 4/18/74 | 6 months |
| Dr. Michael R. MacLaury<br>Stanford University (now with GE) | Coordination Complexes | Institute of Catalysis, Novosibirsk | 4/18/74 | 4 1/2 months |
| Dr. Thomas Weil<br>University of Chicago | Coordination Complexes | Institute of Organo-Element Chemistry, Moscow | 4/18/74 | 4 months |
| Dr. Dean A. Van Leirsburg<br>Rice University | Environmental Control | Institute of Catalysis, Novosibirsk | 5/23/74 | 3 months |
| Dr. Thomas Notermann<br>University of Wisconsin | Catalytic Systems | Institute of Chemical Physics, Moscow | 5/29/74 | 6 months |
| Dr. Kathleen C. Taylor<br>General Motors Research Laboratories | Catalytic Systems | Principal Research: Institute of Catalysis, Novosibirsk; one week at Institute of Physical Chemistry, Kiev | 10/15/74 | 3 months |
| Dr. Duane D. Bruns<br>University of Houston | Reactor Modeling | Institute of Catalysis, Novosibirsk | 3/1/75 | 4 months |

| Research Fellow | Project Area | Location | Date of Arrival, USSR | Length of Visit 1/ |
|---|---|---|---|---|
| r. Randall Partridge<br>Mobil Research &<br>Development Corp. | Life Support Systems | Institute of Chemical Physics, Moscow | 3/1/75 | 6 months |
| r. William C. Conner<br>University of Wisconsin | Catalytic Systems | Institute of Organic Chemistry, Moscow; Institute of Catalysis, Novosibirsk; laboratory visits in Kiev and Leningrad | 3/6/75 | 6 months |
| r. Robert Miner<br>Princeton University | Catalytic Systems | Kirghiz SSR Academy, Alma Ata; laboratory visits in Moscow and Leningrad | 4/7/75 | 3 months |
| r. Roy H. Magnuson | Coordination Complexes | Principal research: Institute of Organo-Element Compounds, Moscow. One-week visits: Institute of Catalysis, Novosibirsk; All-Union Scientific Research Institute for Petro-chemical Processes, Leningrad; Institute of Chemical Physics, Moscow | 4/10/75 | 6 months |

1/ Two month extension, to September 1, suggested by Soviet Institute and endorsed by U.S. sponsor.


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| Research Fellow | Project Area | Location | Date of Arrival, USSR | Length of Visit |
|---|---|---|---|---|
| Dr. Wayne Pretzer<br>Cornell University | Coordination Complexes | Institute of Chemical Physics, Moscow.<br>Visits to: Institute of Organo-Element Compounds and Institute of General & Inorganic Chemistry, Moscow; Institute of Catalysis, Novosibirsk; Institute of Physical Chemistry, Kiev | 6/14/75 | 6 months |

# U.S.S.R. RESEARCH FELLOWS VISITING THE U.S.

| Research Fellow | U.S.S.R. Supervisor | Location | U.S. Supervisor | Date of Arrival | Length of research |
|---|---|---|---|---|---|
| Dr. Kirill I. Zamaraev<br>Inst. of Chemical Physics,<br>Moscow | Prof. A. E. Shilov | Cornell Univ.<br>Univ. of Chicago<br>Stanford Univ. | Prof. E.L. Muetterties<br>Prof. J. Halpern<br>Prof. J. P. Collman | 11/29/74 | 1 month<br>1 month<br>1 month |
| Dr. Vladislav A. Shvets<br>Inst. of Organic Chemistry<br>Moscow | Prof. V. B. Kazanskiy | Stanford Univ. | Prof. M. Boudart | 11/29/74 | 1 mt |
| Dr. Vladislav A. Seleznev<br>Inst. of Chemical Physics<br>Moscow | Prof. O. V. Krylov | Worcester Polytechnic Institute | Prof. A. H. Weiss | 1/3/75 | 1 month |
| Dr. Andrey V. Skliarov<br>Inst. of Chemical Physics<br>Moscow | Prof. O. V. Krylov | University of Wisconsin-Milwaukee | Prof. G.W. Keulks | 1/3/75 | 1 month |

# U.S.S.R. RESEARCH FELLOWS CLEARED TO VISIT IN THE UNITED STATES

| Research Fellow | Project Area | Location | Date of Arrival in the U.S. | Length of Visit |
|---|---|---|---|---|
| Dr. Vyacheslav M. Mastihin<br>Institute of Catalysis<br>Novosibirsk | Catalytic Systems | Princeton University | July 11, 1975 | 6 months |
| Dr. Valeriy I. Savchenko<br>Institute of Catalysis<br>Novosibirsk | Catalytic Systems | General Motors Corporation, California Institute of Technology | July 11, 1975 | 6 months |
| Dr. Vladimir M. Tapilin<br>Institute of Catalysis<br>Novosibirsk | Catalytic Systems | California Institute of Technology | July 11, 1975 | 6 months |


Approved For Release 2001/09/03 : CIA-RDP79-00798A000300040019-1

## US RESEARCH FELLOWS

### DATA SHEETS SENT TO THE USSR ACADEMY OF SCIENCES

| Research Fellow | Project Area | Location | Date of Arrival | Length of Research |
|---|---|---|---|---|
| Dr. James A. Dumesic<br>Department of Chemistry<br>Stanford University | Selected Catalytic Systems | Institute of Chemical Physics<br>Moscow | 8/15/75 | 3 months |
| Dr. William Egelhoff, Jr.<br>Dept. of Chem. Eng.<br>CalTech | Selected Catalytic Systems | Institute of Catalysis<br>Novosibirsk | 9/1/75 | 3 1/2 m |

### USSR RESEARCH FELLOWS - DATA SHEETS RECEIVED

### NOT YET PROCESSED

| | | | | |
|---|---|---|---|---|
| Dr. Boris N. Kuznetsov<br>Institute of Catalysis<br>Novosibirsk | Coordination Complexes | Department of Chemistry<br>Stanford Univ. (Collman) | Sept. 1975 | 6 month |
| Dr. Vladimir A. Likholobov<br>Institute of Catalysis<br>Novosibirsk | Coordination Complexes | Department of Chemistry<br>Stanford Univ. (Collman) | Sept. 1975 | 6 month |

ITINERARY - ACADEMICIAN GEORGIY K. BORESKOV
Director, Institute of Catalysis
Novosibirsk

| | | |
|---|---|---|
| Friday, June 13 | | Arrival in Washington<br>Delegation will be met by Dr. Richard Kenyon |
| Saturday, June 14 | | Meeting in Washington with Dr. P. Arnold, Phillips Petroleum Company |
| | Evening | Orientation meeting and dinner sponsored by the American Chemical Society, Cosmos Club |
| Sunday, June 15 | 2:10 PM | Depart Washington National Airport, DELTA #30 |
| | 3:17 PM | Arrive Boston<br>Go to the UNITED Air Terminal, look for the VERMONT TRANSIT Bus Line - board "New London," bus |
| | 4:00 PM | Depart for New London, New Hampshire<br>Arrive at Colby College |
| Monday, June 16 - Thursday, June 19 | | Participation in the Gordon Conference on Catalysis |
| Friday, June 20 | 7:30 AM | Depart New London on VERMONT TRANSIT BUS |
| | 10:25 AM | Arrive Boston Logan Airport |
| | 12:10 PM | Depart Boston - UNITED, Flight #769 |
| | 1:50 PM | Arrive Cleveland, Ohio<br>Will be met by a representative of Dr. Idol<br>Will be driven by car to Warrensville Heights<br>Reservations at Somerset Inn (Tel.:216-752-56 |
| | Afternoon | Visit with Dr. James Idol, SOHIO |
| | Evening | Dinner guest of Dr. Idol |
| Saturday, June 21 | 8:10 AM | Depart Cleveland, UNITED #326 |
| | 9:27 AM | Arrive La Guardia Airport, New York<br>Will be met by Prof. J. Turkevich<br>Travel by car to Princeton, N.J. Accommodatio<br>Nassau Inn. |
| Monday, June 23 - Wednesday, June 25 | | US/USSR Joint Annual Symposium, Chemical Cat<br>Program |
| | Afternoon | Visit laboratories in Princeton area |
| Thursday, June 26 | 9:51 AM | Depart Princeton for New York by train-<br>Accommodations - New York Hilton Hotel, 1335<br>of the Americas, New York City (Tel.212-586- |
| Friday, June 27 | 1:30 PM | Depart New York for Washington on Metroliner train #115 |
| | 4:30 PM | Arrive Washington Union Station |
| | 5:00 PM | Travel by limousine to Dulles International |
| | 8:10 PM | Depart Washington for Moscow |

ITINERARY - Prof. Ya. B. Gorokhovatskiy & Dr. A. A. Ivanov

| | | |
|---|---|---|
| Sunday<br>Friday, June 13 | | Arrival in Washington |
| Saturday, June 14 | | Sightseeing in Washington |
| | Evening | Orientation meeting & entertainment by the American Chemical Society |
| Sunday, June 15 | 12:20 PM | Depart Washington National Airport<br>NORTHWEST Airline, Flight #325 |
| | 1:35 PM | Arrive Detroit Metropolitan Airport<br>Will be met by Dr. Larson or one of his representatives<br>Reservations Hilton Inn in Troy |
| Monday, June 16 | | Visit General Motors, Research Labs. with Dr. J. G. Larson |
| Tuesday, June 17 | | Visit Automobile Assembly Plant - Dr. Larson |
| | Evening | Dr. Larson will provide transportation to Dearborn, Michigan<br>Reservations at Dearborn Inn |
| Wednesday, June 18 | | Visit Ford Motor Company, Research Labs. with Dr. Yao |
| Thursday, June 19 | 7:00 AM | Depart Detroit, Michigan, EASTERN #341 |
| | 7:43 AM | Arrive Pittsburgh<br>From the airport take a limousine to WILLIAM PENN Hotel on Grand Street in downtown Pittsburgh; walk one block to the Gulf Building - |
| | 10:00 AM | Take the station wagon bus (the driver will have been instructed about your boarding the the station wagon) - You will be driven to the Gulf Research Laboratories<br>Either Dr. Andrew Labun or Dr. John Freel will serve as your host<br>In the evening you will be taken to the CARLTON HOUSE |
| Friday, June 20 | | Take a bus to return to Pittsburgh airport |
| | 12:00 Noon | depart Pittsburgh ALLEGHENY #938 |
| | 1:03 PM | arrive La Guardia Airport, New York |
| | 2:35 PM | Connect DELTA #528 to depart for Worcester, M |
| | 3:15 PM | Arrive Worcester Massachusetts<br>Will be met at the airport by Dr. Weiss' repr<br>Reservations - Lincoln Sheraton |
| Saturday, June 21 | | Visit with Dr. A. Weiss, Worcester Polytechni Institute |
| Sunday, June 22 | | Drive by car to Princeton with Dr. A. Weiss |

Itinerary - Prof. Ya. Gorokhovatskiy & Dr. A. Ivanov
Page 2

| | | |
|---|---|---|
| Monday, June 23 - Wednesday, June 25 | | US/USSR Annual Symposium, Chemical Catalysis Program |
| Thursday, June 26 | 9:51 AM | Depart Princeton for New York by train<br>Reservations - New York Hilton Hotel |
| Friday, June 27 | 1:30 PM | Depart New York for Washington by train |
| | 8:10 PM | Depart Washington for Moscow |

ITINERARY - Prof. Vladimir M. GRYAZNOV

| | | |
|---|---|---|
| Friday, June 13 | Evening | Arrival in Washington<br>Accommodations - Statler Hilton Hotel |
| Saturday, June 14 | | Visit Washington |
| | Evening | Orientation meeting and entertainment by the American Chemical Society |
| Sunday, June 15 | 2:10 PM | Depart Washington National Airport, DELTA #302 |
| | 3:17 PM | Arrive Boston, Logan Airport<br>Go to the UNITED Airline Terminal, look for the VERMONT TRANSIT Bus Line - board "New London, N.H bus |
| | 4:00 PM | Depart for New London, New Hampshire |
| | 6:00 PM | Arrive New London |
| Monday, June 16 - Thursday, June 19 | | Participation in the Gordon Conference<br>Sometime during the Gordon Conference, reconfirm with Dr. Alexander Cruickshank your intention to the bus to return to Boston on Friday, June 20 |
| Friday, June 20 | Noon | Depart for Boston Logan Airport |
| | Approx.3:30 PM | Arrive Boston |
| | 6:25 PM | Depart Boston on PILGRIM Airline #169 |
| | 7:40 PM | Arrive New Haven, Conn. Take a taxi to PARK PLAZ HOTEL. Dr. Gary L. Haller will call you at the hotel to make arrangements for Saturday, June 21 to visit Yale University with a group of other foreign visitors |
| Saturday, June 21 | | Visit Yale University |
| Sunday, June 22 | 8:40 AM | Depart New Haven by train for New York |
| | 10:20 AM | Arrive New York Penn Central Station |
| | 12:00 Noon | Depart New York on Penn Central Train #211 |
| | 12:58 PM | Arrive Princeton Junction<br>Will be advised later on arrangements to travel to Nassau Inn Hotel in Princeton |
| Monday, June 23 - Wednesday, June 25 | | Participation in the US/USSR Joint Symposium, Chemical Catalysis Program<br>Sometime during the symposium contact Dr. H. Heineman to schedule visit to the Mobil Research Development Corporation |

| | | |
|---|---|---|
| Thursday, June 26 | 8:55 AM | Depart Princeton by train to travel to Wilmington, Delaware |
| | 9:38 AM | Arrive Wilmington<br>Will be met by Dr. Bruce C. Gates to travel by car to the University of Delaware<br>Should you arrive on a different train, take a t to the Chemical Engineering Department, Univ. of Delaware, Lovett Avenue and Academy Street.<br>(Dr. Gates hopes to meet you at the Gordon Conf. |
| | Visit with Dr. Gates at the Department of Chemical Engineering.<br>(Prof. James Katzer, Univ. of Delaware, Presiden of the Philadelphia Catalyst Club also will atte Princeton Symposium. If he remains in Princeton until June 25 - last day of the symposium - you may travel with him to the Univ. of Delaware tha afternoon, spend the night in Newark and visit w Dr. Gates on Thursday, June 26. | |
| | Evening | Depart by train to Washington<br>Reservations - Statler Hilton Hotel |
| Friday, June 27 | 8:10 PM | Depart Washington for Moscow |

ITINERARY - Prof. VLADIMIR B. KAZANSKIY
Deputy Director, Institute of Organic Chemistry
USSR Academy of Sciences

| | | |
|---|---|---|
| Friday, June 13 | | Arrival in Washington<br>Will be met by Dr. Richard L. Kenyon |
| Saturday, June 14 | 10:00 AM | Dr. Milton D. Scheer, Chief, Physical Chemistry, Division, National Bureau of Standards, will cal for you at the hotel and drive you to the Chemistry Building at the National Bureau of Standards for a meeting. (Dr. David R. Penn may also be present at the meeting. Dr. John Yates w be unable to meet with you at that time, but wil try to meet with you sometime during the Gordon Conference in New London, N.H.)<br>At the conclusion of the meeting, Dr. Scheer wil drive you back to the hotel. |
| | 6:30 PM | Orientation meeting and dinner at the Cosmos Club, sponsored by the American Chemical Society |
| Sunday, June 15 | 2:10 PM<br>3:17 PM | Depart Washington National Airport, DELTA #302<br>Arrive Boston, Logan Airport<br>Go to the UNITED Airline Terminal, look for the VERMONT TRANSIT Bus Line - board "NEW LONDON, N. bus. |
| | 4:00 PM<br>6:00 PM | Depart for New London, New Hampshire<br>Arrive at Colby College |
| Monday, June 16 - Thursday, June 19 | | Participation in the Gordon Conference. Sometim during the Gordon Conference, reconfirm with Dr. A. Cruickchank your intention to use the bus to return to Boston on Friday, June 20. |
| Friday, June 20 | Noon | Depart New London for Boston<br>Get off at the CONTINENTAL TRAILWAYS Bus Station<br>Take a bus to Worcester, Mass. (hourly schedule.<br>Upon arrival at Worcester, take a taxi to the SHERATON LINCOLN HOTEL. Professor A. Weiss (Worcester Polytechnic Institute) will contact you that evening. |
| Saturday, June 21 | | Visit with Dr. A. H. Weiss |
| Sunday, June 22 | | Drive by car with Prof. Weiss to Princeton, N.J.<br>Reservations - Nassau Inn. |
| Monday, June 23 - Wednesday, June 25 | | US/USSR Joint Symposium |
| | Afternoon | Visit laboratories in Princeton area |

Itinerary - Prof. Kazanskiy
Page 2

| | | |
|---|---|---|
| Thursday, June 26 | 9:51 AM | Depart Princeton for New York by train<br>Reservations - New York Hilton Hotel, 1335 Avenue of the Americas |
| Friday, June 27 | 1:30 PM | Depart New York for Washington by train, METROLINER #115 |
| | 4:30 PM | Arrive Washington Union Station |
| | 5:00 PM | Travel by Greyhound limousine to Dulles Airport |
| | 8:10 PM | Depart Washington for Moscow |

ITINERARY - Prof. Oleg V. KRYLOV
Deputy Director, Institute of Chemical Physics
USSR ACADEMY OF SCIENCES

| | | |
|---|---|---|
| Friday, June 13 | | Arrival in Washington - Accommodations - Statler Hilton<br>Will be met by Dr. Richard L. Kenyon |
| Saturday, June 14 | 10:00 AM | Dr. Milton D. Scheer, Chief, Physical Chemistry Division, National Bureau of Standards, will call for you at the hotel and drive you to the Chemistry Building at the National Bureau of Standards for a meeting. (Dr. David R. Penn may also be present at the meeting. Dr. John Yates will be unable to meet with you at that time, but will try to meet with you sometime during the Gordon Conference in New London, N.H.) At the conclusion of the meeting, Dr. Scheer will drive you back to the hotel. |
| | 6:30 PM | Orientation meeting and dinner at the Cosmos Club, as guests of the American Chemical Society |
| Sunday, June 15 | 2:10 PM<br>3:17 PM | Depart Washington National Airport, DELTA #302<br>Arrive Boston, Logan Airport<br>Go to the UNITED Airline Terminal, look for the VERMONT TRANSIT Bus Line - board "New London, N.H." bus |
| | 4:00 PM<br>6:00 PM | Depart for New London, New Hampshire<br>Arrive at Colby College |
| Monday, June 16 - Thursday, June 19 | | Participation in the Gordon Conference. Sometime during the Gordon Conference, reconfirm with Dr. A. Cruickshank your intention to use chartered bus to return to Boston on Friday, June 20. |
| Friday, June 20 | Noon | Depart New London for Boston<br>Get off at the CONTINENTAL TRAILWAYS Bus Station. Take a bus to Worcester, Mass. (hourly schedule). Upon arrival at Worcester, take a taxi to the SHERATON LINCOLN HOTEL. Prof. Alvin H. Weiss will contact you that evening. |
| Saturday, June 21 | | Visit to Worcester Polytechnic Institute with Prof. Weiss. |
| Sunday, June 22 | | Drive by car with Prof. Weiss to Princeton, N. J.<br>Reservations - Nassau Inn |
| Monday, June 23 - Wednesday, June 25 | | Participate in the US/USSR Annual Joint Symposium<br>During the first day of the symposium, contact Dr. Heinz Heinemann to schedule a visit to the Mobil Research & Development Corp. with Dr. Heinemann and Dr. P. B. Weisz. |

| | | |
|---|---|---|
| Thursday, June 26 | 9:51 AM | Depart Princeton for New York by train<br>Reservations - New York Hilton Hotel, 1335 Avenue of the Americas |
| Friday, June 27 | 1:30 PM | Depart New York for Washington by Metroliner, Train #115 |
| | 4:30 PM | Arrive Washington Union Station |
| | 5:00 PM | Travel by Greyhound limousine to Dulles Airport |
| | 8:10 PM | Depart Washington for Moscow |

ITINERARY - Prof. Alexander E. SHILOV
Deputy Director, Institute of Chemical Physics
USSR Academy of Sciences

| | | |
|---|---|---|
| Friday, June 13 | Evening | Arrival in Washington. Will be met by Dr. Richard Kenyon. Reservations - Statler Hilton Hotel |
| Saturday, June 14 | | Visit Washington |
| | 6:30 PM | Orientation meeting and dinner sponsored by the American Chemical Society - Cosmos Club |
| Sunday, June 15 | 2:10 PM | Depart Washington National Airport, DELTA #302 |
| | 3:17 PM | Arrive Boston, Logan Airport<br>Go to the UNITED AIRLINE TERMINAL, Look for the VERMON TRANSIT Bus line - board "New London, N.H." bu |
| | 4:00 PM | Depart for New London, New Hampshire |
| | 6:00 PM | Arrive New London, Colby College |
| Monday, June 16 - Thursday, June 19 | | Participate in the Gordon Conference on Catalysis. Reconfirm with Dr. Alexander Cruickshank your intention to return to Boston on Chartered bus, Friday, June 20. (Colby Sawyer's College can be visited any time during your stay at New London. There will be someone to take you around.) |
| Friday, June 20 | Noon | Depart on chartered bus for Boston Logan Airport |
| | 3:30 PM | Arrive Boston Logan Airport |
| | 4:45 PM | Depart Boston, ALLEGHENY #981 |
| | 8:44 PM | Arrive Dayton, Ohio. Wait for Prof. Yatsimirskiy's arrival at 9:25 PM on DELTA #393 . At that time Professor William E. Newton will be there to meet you<br>Reservations - Holiday Inn (West), Springfield, Ohio<br>Tel.: 513-324-5561 |
| Saturday, June 21 | | Visit Kettering Research Institute, Yellow Springs, Ohio with Dr. Newton |
| Sunday, June 22 | 12:55 PM | Depart Dayton, ALLEGHENY #534 |
| | 1:40 PM | Arrive Pittsburgh, Penn. |
| | 3:00 PM | Depart Pittsburgh, TWA 160 |
| | 4:02 PM | Arrive Newark, N. J. Check with the SALEM TRANSPORT DESK for limousine service to Princeton. Travel to Princeton - Reservations - Nassau Inn. |
| Monday, June 23 - Wednesday, June 25 | | US/USSR Annual Symposium, Chemical Catalysis Program |
| | Afternoon, 6/25 | Visit laboratories in Princeton area |
| Thursday, June 26 | 9:51 AM | Depart Princeton for New York by train Reservations New York Hilton Hotel, 1335 Avenue of the Americas |
| Friday, June 27 | 1:30 PM | Depart New York for Washington on METROLINER, Train # |
| | 4:30 PM | Arrive Washington Union Station |
| | 5:00 PM | Travel by Greyhound Airport limousine to Dulles Airpo |
| | 8:10 PM | Depart Washington for Moscow |

ITINERARY - PROF. MIKHAIL G. SLIN'KO AND DR. DMITRY A. KONDRATIEV
Institute of Catalysis, Novosibirsk - Inst. of Organic Chemistry
Moscow

| | | |
|---|---|---|
| Friday, June 13 | | Arrival in Washington |
| Saturday, June 14 | Evening | Visit Washington<br>Orientation meeting and dinner sponsored by the American Chemical Society |
| Sunday, June 15 | 12:50 PM | depart Washington National Airport, NORTHWEST Flight #69 |
| | 2:08 PM | Arrive Minneapolis, Minnesota<br>Will be met by Prof. R. Aris<br>Reservations - Radisson Downtown Hotel |
| Monday, June 16 | | Visit University of Minnesota with Prof. Aris |
| Tuesday, June 17 | 11:20 AM | Depart Minneapolis, ALLEGHENY, Flight #894 |
| | 1:58 PM | Arrive Buffalo, New York<br>Will be met by Prof. H. Ray or a representative |
| Wednesday, June 18 | | Visit Dept. of Chem. Eng., State Univ. of New York with Prof. Ray |
| Thursday, June 19 | 9:40 AM | Depart Buffalo, N.Y., EASTERN #125 |
| | 10:38 AM | Arrive Philadelphia. Will be picked up by a chauffeur from Mobil Research and Development Co<br>Reservations - Warwick Hotel - 1701 Locust Street<br>(Tel.: 215-PE5-3800) |
| | | Visit with Dr. Vern W. Weekman, Jr., Mobil Research & Development Corporation, Paulsboro, N.<br>(Tel. 609-423-1040) |
| Friday, June 20 | | Remain in Philadelphia. Rest and tour the histori town - considered the cradle of American Independe |
| Saturday, June 21 | 8:48 AM | Depart Philadelphia by train (take a taxi to the train station) |
| | 9:15 AM | Arrive Wilmington, Delaware<br>Prof. James Katzer, Pres. of the Philadelphia Catalyst Club, or one of his representatives will meet you upon arrival<br>Visit Prof. Katzer at the University of Delaware |
| Sunday, June 22 | 10:47 AM | Depart Wilmington for Philadelphia by train |
| | 11:15 AM | Arrive Philadelphia |
| | 12:15 PM | Depart Philadelphia for Princeton Junction<br>Take a taxi to Nassau Inn in Princeton |

Itinerary - Prof. Slin'ko and Dr. Kondratiev

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|---|---|---|
| Monday, June 23 - Wednesday, June 25 | | US/USSR Joint Annual Symposium, Chemical Catalysis Program |
| | Afternoon, June 25, visit laboratories in Princeton area | |
| Thursday, June 26 | 9:51 AM | Depart Princeton for New York by train<br>Accommodations - New York Hilton Hotel<br>1335 Avenue of the Americas, New York City |
| Friday, June 27 | | Travel by train to Washington |
| | 8:10 PM | Depart Washington for Moscow |

ITINERARY - Prof. Konstantin B. YATSIMIRSKII
Director, Institute of Physical Chemistry
Ukrainian SSR Academy of Sciences

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|---|---|---|
| Friday, June 13 | | Arrival in Washington - Reservations Statler Hilton<br>Will be met by Dr. Richard L. Kenyon |
| Saturday, June 14 | | Visit Washington |
| | 6:30 PM | Orientation meeting and dinner at the Cosmos Club as a guest of the American Chemical Society |
| Sunday, June 15 | 4:50 PM | Depart Washington, Dulles Airport, OZARK #909 |
| | 5:21 PM | Arrive Champaign, Illinois<br>Will be met by Dr. David Hendrickson -<br>Reservations at Illini Inn |
| Monday, June 16 | | Visit University of Illinois, Urbana, Ill. with Prof. D. Hendrickson (Tel.217-333-2685)<br>(Dr. Hendrickson would like for you to be prepared to present a report at the Univ. of Illinois.) |
| Tuesday, June 17 | 11:41 AM | Depart Champaign, Ill., OZARK 932 |
| | 12:18 PM | Arrive Chicago, Ill.<br>Will be met by Prof. J. Halpern or a representative<br>Reservations - Palmer House |
| | | Visit University of Chicago with Prof. Halpern |
| Wednesday, June 18 | | Visit Northwestern University with Prof. Fred Basolo (Tel. 312-492-3500) and Prof. James Ibers (Tel.: 312-492-5449) |
| Thursday, June 19 | 11:40 AM | Depart Chicago, UNITED #210 |
| | 1:40 PM | Arrive Detroit, Michigan<br>Will be met by Prof. Stanley Kirschner. Prof. Kirschner would like you to present a report on the 19th sometime between 3:30 and 4:30 PM. Please telephone him to give him exact title of your report. |
| Thursday, June 19 and Friday, June 20 | | Visit Wayne State Univ. with Prof. Stanley Kirschner. Prof. Kirschner invites you to be a guest at his home 26515 Parkwood Drive, Huntington Woods, Mich. (Tel.: 313-577-2571; home: 313-547-3602) |
| | 8:47 PM | Depart Detroit, Michigan, DELTA #393 |
| | 9:25 PM | Arrive Dayton, Ohio<br>Will be met by Dr. William E. Newton. Reservations-Holiday Inn (West), Springfield, Ohio |
| Saturday, June 21 | | Visit Kettering Research Institute, Yellow Springs, Ohio with Dr. W. Newton |

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|---|---|---|
| Sunday, June 22 | 12:55 PM | Depart Dayton, ALLEGHENY #534 |
| | 1:40 PM | Arrive Pittsburgh, Penn. |
| | 3:00 PM | Depart Pittsburgh, TWA 160 |
| | 4:02 PM | Arrive Newark, N. J. |
| | | Check with SALEM TRANSPORTATION DESK for limousine service to Princeton. Travel to Princeton. Reservations at NASSAU INN on Palmer Square |
| Monday, June 23 - Wednesday, June 25 | | US/USSR Annual Symposium, Chemical Catalysis Program |
| | Afternoon, June 25 | Visit laboratories in Princeton area |
| Thursday, June 26 | 9:51 AM | Depart Princeton for New York by train<br>Reservations - New York Hilton Hotel |
| Friday, June 27 | 1:30 PM | Depart New York for Washington on METROLINER, Train #115 |
| | 4:30 PM | Arrive Washington Union Station |
| | 5:00 PM | Travel by Greyhound Airport Limousine to Dulles International Airport |
| | 8:10 PM | Depart Washington for Moscow |

TOPIC I. Catalysis by Coordination Complexes and Organometallic Compounds

Report of Coordinators

The US and USSR Coordinators of Topic I met in Princeton, N.J., U.S.A. during June 23-25, 1975, to review the progress accomplished dur the past year, to assess the present status of the project, and to develop recommendations for implementation of the project during the coming year.

I. Progress during past year (July 1974-June 1975)

1. Visits by Principal Investigators

Professors Halpern and Collman visited the USSR in July 1974 to attend the US-USSR Catalysis Meeting in Novosibirsk and to visit the Institute of Chemical Physics in Moscow.

Professor Muetterties visited the Institute of Chemical Physics in Moscow during June 1975.

Professor Yermakov visited Stanford University and other researcl laboratories in the USA during November 1974.

Professor Shilov visited the USA in April 1974 and in June 1975 to attend the US-USSR Meeting in Catalysis in Princeton, to attend the Gordon Conference of Catalysis, and to visit various universities and research institutes.

2. Working Visits by Postdoctoral Research Fellows

The following visits were implemented during this period.

(a) US Fellows to USSR

| Fellow | Sponsor | Principal Institutes Visited in USSR | Period of Visit | Principal Top of Research |
|---|---|---|---|---|
| Dr. T.A.Weil | Prof.Halpern (U. of Chicago) | Inst. of Organo-element Compounds Moscow (Prof. Vol'pin) | Apr. '74- Aug. '74 | Redox Chemist of Organometa Compounds |
| Dr. M.MacLaury | Prof.Collman (Stanford U.) | Inst. of Catalysis Novosibirsk (Prof. Yermakov) | Apr. '74- Sept. '74 | Hydrogenation Supported Palladium Cat lysts |
| Dr. R. Magnuson | Prof. Halpern (U. of Chicago) | Inst. of Organo-element Compounds Moscow (Prof. Vol'pin) | Apr. '75 (for 6 mos.) | Redox Chemist of Organometa Compounds |

In addition, Dr. W. R. Pretzer has just arrived in June 1975 from Prof. Muetterties laboratory to commence a period of research in the laborato of Professor Shilov.

(b) USSR Fellows to USA

| Fellow | Sponsor | Principal Insts. Visited in USA | Period of Visit | Principal Topi of Research |
|---|---|---|---|---|
| Dr. K. Zamaraev | Prof.Shilov (Inst. of Chem. Physics, Moscow) | Cornell Univ. (Prof.Muetterties) | Dec. '74- May '75 | Investigation metal cluster compounds of catalytic inte |

3. Research Accomplishments and Publications

Research accomplished by exchange postdoctoral fellows during the above visits encompassed the following themes:

T.A. Weil

Electrochemical reduction of organo-cobalt chelate complexes and the catalytic reduction of $CO_2$ (with Prof. Vol'pin).

M. MacLaury

Catalytic hydrogenation of olefins over supported palladium complex catalysts, and evaluation of the selectivity of such catalysts (with Prof. Yermakov)

K. Zamaraev

1. Study of the dissociation of $[Fe(CO)_3(C_3H_5)]_2$ and related complexes into the component monomers by electron spin resonance, and evaluation of the Fe-Fe bond dissociation energies (with Prof.Muetterti

2. ESR and catalytic studies of cobalt(0) complexes (with Prof. Muetterties).

3. ESR studies on organo-cobalt radical cations (with Prof. Halpe

This research resulted in the following reports and publications

(a) Presented at the US-USSR Meeting on Catalysis in Princeton, June 19

T.A.Weil, "Reduction of Cobalt Chelate Complexes"

M.R.MacLaury, "Hydrogenation of Olefins on Supported Palladium Catalysts"

(b) Publications

1. E.L. Muetterties, B. Sosinsky, and K. Zamaraev, "Cluster Catalysis II. Catalytic Chemistry of $[Fe(CO)_3(C_3H_5)]_2$." Submitted to J. Amer. Chem. Soc.

2. F. J. Kirsekorn, E.L. Muetterties, L.J. Stuhl and K. Zamaraev, "ESR and Catalytic Studies of Cobalt (0)." in press.

3. J. Halpern, J.A. Topich and K. Zamaraev, "Electron Paramagnetic Resonance Spectra and Electronic Structures of Organobis(dimethylglyoximato)cobalt(IV) Complexes." Prepared for publication

4. V.L. Kuznetsov, M.R. MacLaury, B.N. Kuznetsov, J.P. Collman and Y.I. Yermakov, "Hydrogenation Catalysts Containing Phosphine Complexes of Palladium Bound to Silica." Prepared for publication.

4. Assessment of Present Status of Project

The coordinators continue to feel that the three specific joint US-USSR projects, recommended for priority implementation in their report of June 27, 1973, are worthwhile and strongly recommend continuation of these projects during the coming year. These projects involve the specific collaboration of the following teams of US and USSR investigators.

| | | |
|---|---|---|
| Prof. J. Halpern | - | Prof. M.E. Vol'pin |
| Prof. E.L. Muetterties | - | Prof. A.E. Shilov |
| Prof. J.P. Collman | - | Prof. Y. Yermakov |

The coordinators are satisfied with the quality of the research accomplished under the joint program to-date and with the caliber of the postdoctoral fellows exchanged under the program.

At the same time they are concerned that the total level of activity under the program falls short of that specified by the US-USSR agreement covering the joint program in catalysis (i.e. 18 man months of postdoctoral participation per year from each side); that two of the participating US laboratories (i.e. those of Prof. Halpern and Prof. Collman) have not yet received any postdoctoral fellows from their counterpart USSR laboratories (i.e. those of Professors Vol'pin and Yermakov respectively); and that the visits of the first two US fellows to the USSR were too short (approximately 4 months each) to accomplish effective programs of research.

II. Recommendations for the Coming Year

In the light of the above assessment it is recommended that for the coming year:

1. The highest priority be accorded to the full implementation of all three presently approved projects at the recommended levels of research and of exchange of principal investigators and of postdoctoral fellows.

2. That the addition of further projects to Topic I be deferred until implementation of the three present projects has been accomplished in full.

3. That, provided that full implementation of the three present projects is accomplished during the coming year, consideration be giv to the addition of a further project during the following year (i.e. after July 1976) on the previously recommended topic of

"Nitrogen Fixation" involving collaboration between Prof. A.E. Shilov of the Institute of Chemical Physics and Prof. J.E. Bercaw of the California Institute of Technology. This recommendation should be reviewed at the next US-USSR Joint Meeting on Catalysis in the USSR in 1976.

4. That consideration of the addition of other topics of joint research under this program should also be deferred until full implementation of the three present projects has been accomplished. Such possible further topics include those recommended for "future implementation" in the Report of the Coordinators of Topic I dated June 27, 1973, as well as a possible program of joint research on the catalysis of redox reactions involving the participation of Prof. K.B. Yatsimirskii, Director of the Institute of Physical Chemistry in Kiev.

J. Halpern

US Coordinator
(J. Halpern)

A. Shilov

USSR Coordinator
(A.E. Shilov)

CATALYSIS BY COORDINATION AND ORGANOMETALLIC COMPOUNDS

PROGRAM of papers presented at US-USSR Joint Conference on Catalysis, Princeton, N.J.; June 1975.

Monday, June 23, 1975

2:00 p.m.: Redox Chemistry and Catalysis

2:00: J. Halpern, "Oxidation of Organometallic Compounds"
2:30: T. A. Weil, "Reduction of Cobalt Chelate Complexes"
3:00: K. B. Yatsimirskiy, "Catalysis of Redox Reactions by Transition Metal Complexes"

3:30 p.m.: Nitrogen Fixation

3:30: A. E. Shilov, "Recent Developments in the Chemistry of Nitrogen Fixation"
4:00: J. E. Bercaw, "Dinitrogen Complexes of Titanium and Zirconium"
4:30: C. E. McKenna, "Binding and Reduction of Hydrocarbons by Nitrogenase"

Tuesday, June 24, 1975

2:00 p.m.: Activation of Hydrocarbons and Related Catalytic Phenomena

2:00: G. W. Parshall, "Activation of Carbon-Hydrogen Bonds"
2:30: A. E. Shilov, "Activation of Hydrocarbons"
3:00: J. R. Norton, "Elimination of Alkyl Groups from Metal Complexes"

3:30 p.m.: Metal Clusters and Supported Catalysts

3:30: E. L. Muetterties, "Catalysis Chemistry of Metal Clusters"
4:00: M. R. MacLaury, "Hydrogenation of Olefins over Supported Palladium Catalysts"

Plenary Lectures

A.E. Shilov, "Polyelectronic Catalytic Reactions in the Presence of Transition Metal Compounds"

E.L. Muetterties, "Catalytic Hydrogenation of Aromatic Hydrocarbons"

TOPIC 2. Catalytic Reactor Modeling

In accordance with the program of US - USSR scientific cooperation, the following work has been started :

1) Investigation of the kinetics of complex reactions under steady and nonsteady-state conditions.

2) Investigation of the stability and dynamics of chemical reactions and reactors.

In the first area, investigation of the kinetics of oxidation reactions of naphthalene in phthalic anhydride under steady and nonsteady-state conditions ( oxidation of CO over platinum and de-hydrogenation of hydrocarbons ) has been carried out in both countries.

In the second area, investigations of the self-oscillations of the reactions of hydrogen with oxygen and hydrogen with CO, stable solutions of partial differential equations of the parabolic type, and the dynamics of exothermal reactions have been carried out.

Duane Bruns has been studying at the Institute of Catalysis the self-oscillations of heterogeneous, catalytic reactions.

The Institute of Catalysis is ready to receive a person from the University of Minnesota in September, 1975. The program has been coordinated with Prof. Aris.

Both sides agreed to continue the exchange program in 1975-1976, as outlined above, and to include the following new topic : " Mathematical modeling of polymerization reactors. " Professor W. Ray, State University of New York at Buffalo and the Institute of Catalysis of the Siberian branch of the USSR Academy of Sciences will participate in this investigation. Theoretical investigation of emulsion polymerization is planned to be carried out in 1975-1976.

Investigation of the dynamics of polymerization reactors is planned to be conducted in 1976-77. The US - USSR program of scientific cooperation principally consists in exchanging scientists. The American side is ready to receive scientists from the USSR in 1975 at the University of Houston and Notre Dame, in 1976 at the University of Buffalo, Berkeley, and in 1976-1977 at the University of Minnesota and Princeton University. The Soviet side will receive US scientists at the Institute of Catalysis and at the Institute of Mathematics of the Siberian Branch of the USSR Academy of Sciences. It was agreed that this joint project would be reviewed in July 1976, and that if progress has not been made by that time in implementing the agreement, that consideration would be given to recommending to the Joint Commission that this project be discontinued.

# PROTOCOL OF DISCUSSION OF U.S.--U.S.S.R. COOPERATIVE PROGRAM IN CHEMICAL CATALYSIS: THEME III--AN IN-DEPTH STUDY OF SELECTIVE CATALYTIC REACTIONS

During 1974-75, the following institutions participated in the exchange of research fellows:

| From U.S.S.R. | From U.S.A. |
|---|---|
| Institute of Catalysis<br>Novosibirsk | University of Wisconsin--Milwaukee |
| Institute of Chemical Physics<br>Moscow | Stanford University |
| Institute of Organic Chemistry<br>Moscow | Princeton University |
| Institute of Physical Chemistry<br>Ukranian Academy of Science | California Institute of Technology |
| Institute of Organic Catalysis and Electrochemistry<br>Alma Ata | General Motors |
| People's Friendship University<br>Moscow | |

Scientific research during this period followed the protocol signed in Moscow August, 1973 and in Novosibirsk July, 1974. Soviet research fellows worked in the U.S.A. for a total of 16 man-months; U.S. research fellows worked in the U.S.S.R. for a total of 21 man-months. Two additional Soviet research fellows (Drs. Tapilin and Mastikhin) are expected to arrive in the U.S.A. in July 1975.

Scientific cooperation involved the following projects:

1. Catalytic oxidation of hydrocarbons
2. Supported metal catalysts
3. Pure metal surfaces
4. Acid-base catalysis and catalysis on zeolites
5. Catalysis on membranes

Work on Project 1 concerning bismuth-iron-molybdate catalysts was carried out by Mr. Thomas Notermann at the Institute of Chemical Physics, laboratories of Professor O. V. Krylov, Moscow. Additional work on the bismuth-iron-molybdate system is continuing by Mr. Thomas

Notermann in the laboratories of Professor G. W. Keulks at the University of Wisconsin--Milwaukee. Dr. Andrey Skliarov, Institute of Chemical Physics, has assisted in this project in both the U.S.S.R. and the U.S.A. There is mutual interest on both sides in this project, and the collaboration has proved to be quite fruitful. Two papers have resulted from this cooperative effort:

1. "The Physicochemical Properties of the Bismuth Iron Molybdate System," by Thomas Notermann, George W. Keulks, A. Skliarov, Yu. Maximov, L. Ya. Margolis, and O. V. Krylov, accepted by the Journal of Catalysis, to be published 1975.

2. "The Physicochemical Properties and Catalytic Activity of Bismuth Iron Molybdate Catalysts," by Thomas Notermann, George W. Keulks, A. Skliarov, A. Frolov, O. Vinogradova, L. Ya. Margolis, and O. V. Krylov, submitted to Kinetics and Catalysis.

Other areas of investigation related to Project 1 were also carried out in Novosibirsk (Academician Boreskov) and at the Institute of Physical Chemistry, Ukranian Academy of Science (Professor Gorokhvatskii). Results of these investigations were presented and discussed at the conference in Princeton.

Work on Project 2 was carried out on supported platinum catalysts by Dr. Andrey Skliarov at the University of Wisconsin--Milwaukee in the laboratories of Professor G. W. Keulks. Investigation of NMR and ESR spectra and properties of small clusters and small metallic particles in zeolites was carried out by Dr. V. A. Shvets at Stanford University in the laboratories of Professor M. Boudart. Investigations of supported catalysts for hydrogenation were carried out by Dr. R. Miner at the Institute of Organic Catalysis and Electrochemistry, laboratories of Professor Sokolski, Alma Ata. Three joint papers are in preparation:

1. "The Investigation of the Dehydrocyclization of Heptane by Thermodesorption Methods," by A. Skliarov, George W. Keulks, and O. V. Krylov.

2. "ESR Investigation of the Structure and Properties of $[Rh\text{-}Rh]^{+}$ Pairs in Rhodium Containing Zeolites," by V. A. Shvets and M. Boudart.

3. "Ferromagnetic Resonance of Palladium Containing Y-Zeolites," by V. A. Shvets and M. Boudart.

Work on the isomerization of olefins on supported metal catalysts is being carried out by U.S. research fellows. Dr. Conners at the Institute

of Organic Chemistry, laboratories of Professor Kazansky, Moscow. Additional investigations related to Project 2 were carried out at General Motors (Dr. J. Larson), at the University of Wisconsin--Milwaukee (Professor W. K. Hall), and at Princeton (Professor Turkevich). Results of these investigations were presented and discussed at the Princeton conference.

Work on Project 3 was carried out by Dr. K. Taylor at the Institute of Catalysis, laboratories of Academician Boreskov, Novosibirsk. Her investigation involved a study of carbon monoxide and nitric oxide adsorption on pure platinum. This work was presented and discussed at Princeton and will be continued at General Motors. Dr. Tapilin, who is also expected to arrive shortly, will work in the laboratories of Professor Weinberg at the California Institute of Technology. Work on Project 3 is also being carried out at the Institute of Chemical Physics in the laboratories of Professor O. V. Krylov.

Work on Project 4 was carried out by Dr. C. Kibby at the Institute of Organic Chemistry, laboratories of Professor Kazansky, Moscow. His work involved the use of high resolution NMR to investigate the formation of π-complexes of olefins on catalysts with bronsted acid centers. One manuscript is in preparation, "NMR Evidence of Adsorbed π-Complexes of Olefins on Acidic Catalysts," by C. Kibby, V. U. Borovkov, and V. B. Kazansky. Work is also in progress at the Institute of Organic Chemistry in the laboratories of Professor H. M. Minacheav and at the University of Wisconsin--Milwaukee in the laboratories of Professor W. K. Hall. Professor Hall's results were presented and discussed at the Princeton conference.

Work on Project 5 was carried out at the Institute of Petrochemical Synthesis of the Soviet Academy of Sciences and at the People's Friendship University, laboratories of Professor V. N. Gryaznov. Membrane alloys were found to be selective hydrogenation catalysts. This work was presented and discussed at the Princeton conference. Work was also carried out at Princeton University in the laboratories of Professor J. Turkevich. He has developed a method of supporting small platinum particles on membrane surfaces.

Both sides note the high quality of the research fellows who have participated in the exchange program. During 1974-75, the principal investigators discussed their joint work during visits to the U.S.S.R. and the U.S.A. The following Soviet principal investigators visited the U.S.A. (number of times in parentheses):

| | |
|---|---|
| O. V. Krylov | (2) |
| V. B. Kazansky | (2) |
| V. M. Gryaznov | (2) |
| Y. B. Gorokhavatskii | (1) |
| H. M. Minacheav | (1) |
| G. K. Boreskov | (1) |

The following American principal investigators visited the Soviet Union:

| | |
|---|---|
| J. Turkevich | (2) |
| G. W. Keulks | (2) |
| W. K. Hall | (1) |
| J. Larson | (1) |
| W. H. Weinberg | (1) |

At the Princeton conference, the status of Theme III was discussed, and it was decided to continue the collaboration in 1976 along the lines mentioned above. For a deeper understanding of heterogeneous catalysis in these particular areas, it would be desirable to have a wider application of quantum-chemical calculations, particularly the exchange of computer programs. Therefore, an effort should be made to carry out a collaborative program in this area. Possible participants are Professor Kazansky and Boudart. It would also be very useful to extend the cooperative work on the application of Mössbauer spectroscopy in catalysis. Development in this direction can be accomplished during visits of research fellows. The number of U.S. participants in Theme III might be expanded to include Professor J. Butt of Northwestern University and Professor G. V. Smith of Southern Illinois University. This proposal will be discussed at the next U.S.--U.S.S.R. meeting.

The exchange visits for 1975-76 of research fellows from both sides were discussed. Table I summarizes the list of U.S. fellows who have worked in the Soviet Union and who may visit the Soviet Union in 1975-76. Table II summarized the status of the exchange as of 6-30-75 and 12-31-75.

Very serious problems arise in connection with the time fellows spent in exchange working on projects defined in Theme III. It is evident that this program has proceeded quite well, and a number of laboratories from both sides are involved (more than any other Theme). The present guideline of 18 man-months is considered by both collaborators to be too small, and it is strongly recommended that this guideline be increased to 36 man-months for exchange visits in Theme III.

Coordinator from American side,
Professor W. Keith Hall

W. Keith Hall/GWK 7/3/75
(Signature) (Date)

Coordinator from Soviet side,
Professor O. V. Krylov

(Signature) (Date)

TABLE I

U.S. RESEARCH FELLOWS TO U.S.S.R.

| Principal Investigator | Year | Fellow Researcher | Time (Months) | Principal Investigator (U.S.S.R.) |
|---|---|---|---|---|
| D. K. Hall | 1974 | C. Kibby* | 6 | V. B. Kazansky |
| | 1975 | W. C. Conners** | 3 | V. B. Kazansky |
| | 1976 | to be appointed | 3 to 6 | V. B. Kazansky |
| D. Larson | 1974 | K. C. Taylor* | 3 | G. K. Boreskov |
| | 1975 | | | |
| | 1976 | J. Gland | 3 | O. V. Krylov |
| D. W. Keulks | 1974 | T. Notermann* | 6 | O. V. Krylov |
| | 1975 | L. D. Krenzke | 6 | O. V. Krylov |
| | 1976 | J. Hall | 6 | O. V. Krylov |
| D. Turkevich | 1974 | | | |
| | 1975 | R. Miner** | 3 | D. V. Sokolski |
| | 1976 | R. Miner | 3 | V. M. Gryaznov |
| L. Boudart | 1974 | | | |
| | 1975 | Dumesic | 3 | V. I. Goldansky |
| | 1976 | E. Kugler | 3 to 6 | |
| H. Weinberg | 1974 | | | |
| | 1975 | W. Egelhoff | 3 | G. K. Boreskov |
| | 1976 | to be appointed | 6 | G. K. Boreskov |

* Worked in U.S.S.R., returned to U.S.A.

** Presently in U.S.S.R.





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TABLE II

STATUS OF EXCHANGE OF RESEARCH FELLOWS

Status as of 6-30-75

| Principal Investigator | Soviet Fellows Sent to U.S.A. | U.S. Fellows Sent to U.S.S.R. |
|---|---|---|
| W. K. Hall | 0 | 9 |
| J. Larson | 0 | 3 |
| G. W. Keulks | 8 | 6 |
| J. Turkevich | 0 | 3 |
| M. Boudart | 7 | 0 |
| W. H. Weinberg | 0 | 0 |

Projected Status as of 12-31-75

| Principal Investigator | Soviet Fellows Sent to U.S.A. | U.S. Fellows Sent to U.S.S.R. |
|---|---|---|
| W. K. Hall | 0 | 9 |
| J. Larson | 3 | 3 |
| G. W. Keulks | 8 | 6 |
| J. Turkevich | 3 | 3 |
| M. Boudart | 7 | 3 |
| W. H. Weinberg | 9 | 3 |

Topic 4. Application of Catalysis to Life Support Systems for Possible Use in Future Space Exploration

Personnel: Dr. M. M. Sakhorov - U.S.S.R. Coordinator
Prof. A. H. Weiss - U.S.A. Coordinator and Principal Investigator, Worcester Polytechnic Institute, Worcester
Prof. O. V. Krylov - Principal Investigator, Institute of Chemical Physics, Moscow
Prof. Y. B. Ghorokhovatiskii - Principal Investigator Institute of Physical Chemistry, Kiev

1974-75 Accomplishments

Professor Alvin H. Weiss made his second trip to the U.S.S.R. under the auspices of the collaboration in November 1974. He visited Moscow, Kiev, Leningrad, and Novosibirsk for a total period of three weeks. Plans were made in Kiev with Dr. Yevmenenko to combine data on $Pb(OH)_2$ catalysis of the formose reaction that had been obtained in Kiev with data on $Ca(OH)_2$ catalysis from W.P.I. The purpose would be to publish a joint paper in early 1975, but this has not yet materialized. Dr. Valdislav Seleznev arrived at W.P.I. on January 5, 1975 for a six-month stay, which was subsequently extended for an additional two months. Mr. Randall Partridge of Mobil Research Corporation spent one month at W.P.I. and then arrived at the Institute of Chemical Physics March 1, 1975 for a four-months stay, subsequently extended to six months. Dr. Seleznev studied batch reaction pH effects, and found that the non-selective Cannizzaro reaction is suppressed by using an externally prepared $Ca(OH)_2$: glucose complex as catalyst, rather than powered $Ca(OH)_2$ or $Ca(OH)_2$

prepared in situ. Two papers describing his work have been prepared and will be submitted for publication. One, "Inherent pH Limitations in Cation Selective Base Catalysis" was present at the Princeton Conference, June 24, 1975. Dr. Seleznev interacts with Messrs. Richard Hedge and Osman Gebizlioglu, who are studying the CSTR reaction, both for instabilities and selectivity control.

Mr. Randall Partridge is working together with Tatyana Chomenko and Olga Golovina under the supervision of Dr. M.M. Sakharov. They have studied UV and NMR spectra of formose and the use of $C^{13}$ and $C^{14}$ tracers. In Kiev Dr. Nikolai Yevmenenko has studied PbO catalysis, pH effects and UV spectra.

1975-76 Plans

1. In addition to obtaining trimethylsilyl ether product distributions of sugars, Dr. V. Seleznev will conclude his stay at W.P.I. by conducting direct FID analysis to detect glycolaldehyde and glyceroaldehyde. He will also make a trickle bet flow reactor operational for subsequent heterogeneous catalysis experiments (on zeolites, resins, etc.) at W.P.I. after his departure.

2. Crown complexes will be tested in the liquid phase, time permitting. Also, hydrogenation experiments will commence by a new graduate student in September, using both macro batch autoclaves and micro high pressure differential scanning calorimetry.

3. CSTR work will incorporate externally prepared catalyst complexes rather than in situ complexing in the CSTR, and further work in oscillation and instabilities will proceed.

4. Dr. S. Ziemecky is scheduled to arrive at W.P.I. August 15 for training in formose prior to his departure November 1 to Moscow or Kiev for four months. There he will do research using tracers for elucidation of mechanism and studying complexes with NMR,UV and solubility.

5. A joint paper will be prepared by A.H. Weiss, O.V. Krylov, M.M. Sakharov and Y.B. Gorokhvatskii comparing various catalysts.

6. It is planned that the second USSR fellow will come from Kiev before April 1, 1976. His research area will be selected to best fit the ongoing activities at W.P.I. including both condensation and hydrogenation products and catalysts of significance.

7. Work on formose proceeding in Moscow will be mainly on mechanism, complex structure, and catalysts. In Kiev further work will proceed using homogeneous Pb catalysts, heterogeneous catalysts, and instrumental techniques.

8. Dr. M.M. Sakharov is expected to visit W.P.I. and other USA facilities for two weeks commencing about October 1, 1975.

(A.H.Weiss) USA Coordinator

(O.V. Krylov) for Dr. M.M. Sakharov,
USSR Coordinator

Princeton, N.J.
June 24, 1975

Manuscripts in Preparation

1. Comparison of $Pb(OH)_2$ and $Ca(OH)_2$ pH Effects in Formaldehyde Condensation, Yevmenenko, Seleznev, Ghorochvatskii, Sakharov, Krylov, and Weiss.
2. Inherent pH Limitations in Cation Selective Base Catalysis, Seleznev, Chomenko, Sakharov, and Weiss.
3. pH Effects in Formaldehyde Condensation, Seleznev and Weiss.

Note: Valerie Gayevski may be the next fellow from Kiev.

JOINT US-USSR TECHNOLOGY EXCHANGE PROGRAM

on

CHEMICAL CATALYSIS

TOPIC 5. ENVIRONMENTAL CONTROL.

NO Decomposition and Reduction

Accomplishments, 1974-75

During the period between September, 1974, and August, 1975, the program on $NO_x$ decomposition and reduction was expanded to include Prof. A. T. Bell (Department of Chemical Engineering, University of California, Berkeley). Prof. J. W. Hightower (Department of Chemical Engineering, Rice University, Houston, Texas) continued his participation in the program. In September, 1974, Dr. D. A. Van Leirsburg joined Hightower's group as the first US participant in the exchange work on $NO_x$ catalysis. Van Leirsburg's work was devoted to the decomposition of NO over supported (Pd-Ni) and Pt catalysts, and Dr. Y.-H. Hu completed a study of the reduction of NO by $CH_4$ over a Pt catalyst supported on alumina. The latter work involved kinetic as well as isotopic tracer studies. After completing his research at Rice, Van Leirsburg worked under Academician Boreskov at the Institute of Catalysis in Novosibirsk on the interaction of NO with clean tungsten surfaces.

Over the past year Prof. Bell has sought a Postdoctoral Fellow to participate in the program. Work on $NO_x$ catalysis relating to the overall exchange objectives has continued in his laboratory. Research was completed on the reduction of NO by CO over copper oxide. These investigations were devoted to both reaction kinetics and to the identification of adsorbed surface species by infrared spectroscopy. Similar efforts are currently under way over a Pt catalyst.

In May of 1974, Hightower, Bell, and Dr. V. Haensel (NO coordinator for the US) visited the N. D. Zelinski Institute of Organic Chemistry in Moscow and the Institute of Catalysis in Novosibirsk. The purpose of this trip was to acquaint researchers with US efforts and to learn about Soviet research and experimental techniques. As a part of this visit a Protocol outlining the objectives of the collaborative efforts was prepared and signed by Boreskov and Haensel.

Plans, 1975-76

Plans for the third year's interactions call for a continuation of the same type of mechanistic studies initiated during the previous two years at Berkeley and at Rice. Specifically, Bell will study the selective reduction